

ANSWERS: Crystal Ball questions on indicators

1) An indicator is a substance that will change colour in a acidic or alkaline solution.

Litmus is a good indicator as it has distinctly different colours in acids (red colour) and bases (blue colour). However, litmus does not give an idea of the strength of a particular acid or base.

Alizarin yellow isn't a very good indicator as it can only distinguish between a strong base of pH 12 – 13 with a violet colour. All the other acid, neutral and weak bases are shown with a yellow colour for Alizarin yellow. Similarly, Thymol blue isn't a very good indicator because it can only distinguish between a strong acid, pH of 1 with a red colour whereas weaker acids, neutral and basic substances show as a yellow colour with thymol blue.

Bromocresol green and purple are good indicators because they also change colour but only give a general idea of the pH level. Bromocresol green shows strong acids with a pH of 1 - 3 with a yellow colour, whereas all the other pH levels are a blue colour. Bromocresol purple shows weak and strong acids with a pH of 1 – 5 as a yellow colour whereas all the other pH levels show up as a violet colour.

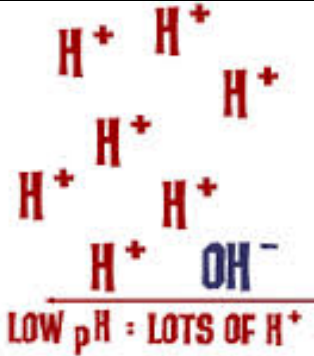
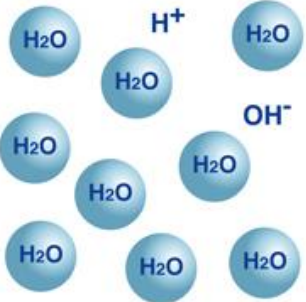
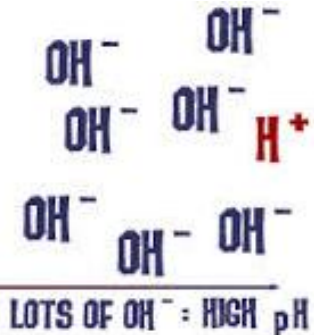
Universal indicator is excellent because it is made up of a mixture of many different coloured dyes and has a range of different colours which indicate a specific pH range. Acids are a red, orange or yellow colour in Universal indicator. A strong acid (eg HCl) with a lot of H^+ ions, has a pH of 1 – 3 and will be a red colour in Universal indicator. A weak acid (eg vinegar) has a lot less H^+ ions, a pH of 4 and will be an orange colour with Universal indicator. An even weaker acid would show as a yellow colour with Universal indicator as the pH is between 5 and less than 7.

Universal indicator also indicates a neutral substance, a pH of 7 with a green colour.

The different strengths of bases are also indicated by Universal indicator, bases will show as a blue, purple or violet colour. A strong base (eg NaOH) with a high concentration of OH^- ions and pH of 11 – 13 will show a violet colour with indicator. A weaker base such a ammonia solution with a pH of 10 will show as a purple colour and very weak bases such a gentle soaps with a pH range of above 7 to 9 will show a blue colour with Universal indicator.

Of the choice of indicators provided in the table Universal indicator has the greatest range of colours and provides a clear idea as to the specific pH range of a substance, so I would choose it to be the “best” indicator of the choices available.

2)

type of solution	stomach acid	pure water	oven cleaner
scientific name	hydrochloric acid	water	sodium hydroxide
chemical formula	HCl	H ₂ O	NaOH
pH range or number	1 - 2	7	12 - 14
colour in Universal indicator	red	green	purple or violet
sketch of a beaker showing H ⁺ and OH ⁻ ions of the solution	 <p><i>the Cl⁻ ions have not been shown</i></p>		 <p><i>the Na⁺ ions have not been shown</i></p>

3) An indicator is a substance that changes colour in an acid or alkali.

Some plants such as yellow marigold and yellow dandelion are not good indicators because they are the same colour in acid, base and neutral solutions.

Some plants parts would be good at distinguishing between an acid and alkali solution but not neutral as they are the same colour in neutral as well as acid or alkali, for example red rose, white rose, white daisy and raw beetroot.

Similarly other plant parts don't have different colours between acid and alkali solutions but do have a different colour in water so could help distinguish them, examples are orange nasturtium and green spinach leaf.

Some excellent indicators in the list above are red hibiscus, red oleander, red canna, red geranium, red dahlia, mauve impatiens, purple lasandra, purple aster and red cabbage leaf. They are excellent indicators of acidic, basic and neutral solutions because they have different colours in each of these solutions eg red hibiscus is has 3 distinctly different colours: pink in neutral solution, orange in acid and blue-green in alkali solutions.

The table implies that usually plant petals are used as indicators but other parts such as leaf and the flesh eg in beetroot could be used. There is no mention of parts such as stem or roots being good indicators.